

Electricity and Magnetism, Poland, GUM (Glowny Urzad Miar, Central Office of Measures)

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
DC voltage sources: single values	Solid state voltage standard	Direct comparison	1.018	10	V			0.2	µV/V	2	95%	Yes			2
DC voltage sources: low values	Multifunction calibrators	Direct comparison	10	100	mV			6E-06	V/V	2	95%	Yes			3
DC voltage sources: low values	Multifunction calibrators	Direct comparison	0.1	10	V			3E-06	V/V	2	95%	Yes			4
DC voltage sources: intermediate values	Multifunction calibrators	Direct comparison	10	1000	V			3.5E-06	V/V	2	95%	Yes			5
DC voltage meters: intermediate values	DC voltmeters, multimeters	Direct comparison	0.22	1100	V			1E-05	V/V	2	95%	Yes			6
DC resistance standards and sources: low values	Fixed resistor, resistor box	Current comparator bridge	0.1	1	Ω	Oil bath temperature	23 °C	0.5	µΩ/Ω	2	95%	Yes			7
DC resistance standards and sources: intermediate values	Fixed resistor, resistor box	Current comparator bridge	1	1E+05	Ω	Oil bath temperature	23 °C	1	µΩ/Ω	2	95%	Yes			8a
DC resistance standards and sources: intermediate values	Fixed resistor, resistor box	Current comparator bridge	1E+06	1E+06	Ω			2	µΩ/Ω	2	95%	Yes			8b
DC resistance standard and sources: multiple ranges	Multifunction calibrators	Direct comparison	1	1.9	Ω			2E-05	Ω/Ω	2	95%	Yes			9
DC resistance standard and sources: multiple ranges	Multifunction calibrators	Direct comparison	0.01	190	kΩ			1E-05	Ω/Ω	2	95%	Yes			10
DC resistance standard and sources: multiple ranges	Multifunction calibrators	Direct comparison	0.3	19	MΩ			3E-05	Ω/Ω	2	95%	Yes			11

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DC resistance standard and sources: multiple ranges	Multifunction calibrators	Direct comparison	30	100	MΩ			3E-04	Ω/Ω	2	95%	Yes			12
DC resistance meters: intermediate values	Ohmmeters, multimeters	Direct comparison	1	1.9	Ω	Resistance	1 Ω, 1.9 Ω	1E-04	Ω/Ω	2	95%	Yes			13
DC resistance meters: intermediate values	Ohmmeters, multimeters	Direct comparison	10	190	Ω	Resistance	10 Ω, 19 Ω, 100 Ω, 190 Ω	3E-05	Ω/Ω	2	95%	Yes			14
DC resistance meters: intermediate values	Ohmmeters, multimeters	Direct comparison	10	190	kΩ	Resistance	10 kΩ, 100 kΩ, 190 kΩ	2E-05	Ω/Ω	2	95%	Yes			15
DC resistance meters: intermediate values	Ohmmeters, multimeters	Direct comparison	1	1.9	MΩ	Resistance	1 MΩ, 1.9 MΩ	3E-05	Ω/Ω	2	95%	Yes			16
DC resistance meters: intermediate values	Ohmmeters, multimeters	Direct comparison	10	19	MΩ	Resistance	10 MΩ, 19 MΩ	5E-05	Ω/Ω	2	95%	Yes			17
DC resistance meters: intermediate values	Ohmmeters, multimeters	Direct comparison	100	100	MΩ	Resistance		1.5E-04	Ω/Ω	2	95%	Yes			18
DC current sources: intermediate values	Multifuncion calibrators	Direct comparison	0.1	100	mA			2.2E-05	A/A	2	95%	Yes			19
DC current sources: intermediate values	Multifuncion calibrators	Direct comparison	0.1	1	A			3E-05	A/A	2	95%	Yes			20
DC current sources: intermediate values	Multifuncion calibrators	Direct comparison	1	10	A			6E-05	A/A	2	95%	Yes			21

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DC current meters: low values	Multimeters, ammeters: current /	Direct comparison	1	100	µA			(6E-05 + I_o/I), $I_o = 10 \text{ nA}$, I in A	A/A	2	95%	Yes			22a
DC current meters: intermediate values	Multimeters, ammeters	Direct comparison	0.1	100	mA			7E-05	A/A	2	95%	Yes			23
DC current meters: intermediate values	Multimeters, ammeters	Direct comparison	0.1	1	A			1E-04	A/A	2	95%	Yes			24
DC current meters: intermediate values	Multimeters, ammeters	Direct comparison	1	11	A			4.5E-04	A/A	2	95%	Yes			25
Capacitance: low loss capacitors	Standard capacitors	Capacitance bridge	0.1	0.1	pF	Frequency	1 kHz	40	µF/F	2	95%	Yes			150
Capacitance: low loss capacitors	Standard capacitors	Capacitance bridge	1	1	pF	Frequency	1 kHz	5	µF/F	2	95%	Yes			26
Capacitance: low loss capacitors	Standard capacitors	Capacitance bridge by substitution	10	10	pF	Frequency	1 kHz, 1.59 kHz	0.5	µF/F	2	95%	Yes			151
Capacitance: low loss capacitors	Standard capacitors	Capacitance bridge by substitution	0.1	1	nF	Frequency	1 kHz, 1.59 kHz	5	µF/F	2	95%	Yes			29
Capacitance: dielectric capacitor	Fixed capacitor, capacitance box	Capacitance bridge	10	100	nF	Frequency	1 kHz, 1.59 kHz	30	µF/F	2	95%	Yes			30
Capacitance: dielectric capacitor	Fixed capacitor, capacitance box	Capacitance bridge	1000	1000	nF	Frequency	1 kHz	50	µF/F	2	95%	Yes			31
Capacitance: dielectric capacitor	Fixed capacitor, capacitance box	Capacitance bridge	10000	10000	nF	Frequency	1 kHz	400	µF/F	2	95%	Yes			32
Inductance: self inductance, low values	Fixed inductors, inductance box	LCR bridge by substitution	1	1	µH	Frequency	1 kHz	50	mH/H	2	95%	Yes			33
Inductance: self inductance, low values	Fixed inductors, inductance box	LCR bridge by substitution	10	10	µH	Frequency	1 kHz	5	mH/H	2	95%	Yes			34

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Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
Inductance: self inductance, low values	Fixed inductors, inductance box	LCR bridge by substitution	50	100	µH	Frequency	1 kHz	400	µH/H	2	95%	Yes			35
Inductance: self inductance, intermediate values	Fixed inductors, inductance box	LCR bridge by substitution	1	1	mH	Frequency	1 kHz	150	µH/H	2	95%	Yes			152
Inductance: self inductance, intermediate values	Fixed inductors	Difference comparator	10	10	mH	Frequency	1 kHz	40	µH/H	2	95%	Yes			36
Inductance: self inductance, intermediate values	Fixed inductors, inductance box	LCR bridge by substitution	100	1000	mH	Frequency	400 Hz, 1 kHz	150	µH/H	2	95%	Yes			37
Inductance: self inductance, high values	Fixed inductors, inductance box	LCR bridge by substitution	10	10	H	Frequency	200 Hz, 400 Hz	400	µH/H	2	95%	Yes			39
AC voltage up to 1000 V: sources	Multifunction calibrators	Direct comparison	1	100	mV	Frequency	20 Hz to 100 kHz	9.8E-05 to 9.9E-04	V/V	2	95%	Yes	ACV Sources and meters		153
AC voltage up to 1000 V: sources	Multifunction calibrators	Direct comparison with standard	1	10	V	Frequency	10 Hz to 1 MHz	2.6E-05 to 1.1E-03	V/V	2	95%	Yes	ACV Sources and meters		154
AC voltage up to 1000 V: sources	Multifunction calibrators	Direct comparison with standard	19	100	V	Frequency	10 Hz to 100 kHz	2.6E-05 to 1.0E-04	V/V	2	95%	Yes	ACV Sources and meters		155
AC voltage up to 1000 V: sources	Multifunction calibrators	Direct comparison with standard	700	1000	V	Frequency	40 Hz to 100 kHz	4.1E-05 to 5.5E-04	V/V	2	95%	Yes	ACV Sources and meters		156
AC voltage up to 1000 V: meters	AC voltmeters, multimeters	Direct comparison with standard	1	10	mV	Frequency	20 Hz to 100 kHz	1.5E-04 to 9.9E-04	V/V	2	95%	Yes	ACV Sources and meters		157
AC voltage up to 1000 V: meters	AC voltmeters, multimeters	Direct comparison with standard	10	100	mV	Frequency	20 Hz to 100 kHz	9.8E-05 to 6.4E-04	V/V	2	95%	Yes	ACV Sources and meters		158
AC voltage up to 1000 V: meters	AC voltmeter, multimeters	Direct comparison with standard	0.1	1	V	Frequency	10 Hz to 1MHz	2.6E-05 to 1.1E-03	V/V	2	95%	Yes	ACV Sources and meters		159
AC voltage up to 1000 V: meters	AC voltmeters, multimeters	Direct comparison with standard	1	10	V	Frequency	10 Hz to 1 MHz	2.6E-05 to 1.1E-03	V/V	2	95%	Yes	ACV Sources and meters		160

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Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
AC voltage up to 1000 V: meters	AC voltmeters, multimeters	Direct comparison with standard	10	100	V	Frequency	10 Hz to 1 MHz	2.6E-05 to 1.1E-03	V/V	2	95%	Yes	ACV Sources and meters		161
AC voltage up to 1000 V: meters	AC voltmeters, multimeters	Direct comparison with standard	100	1000	V	Frequency	10 Hz to 100 kHz	2.9E-05 to 5.5E-04	V/V	2	95%	Yes	ACV Sources and meters		105
AC current up to 100 A: sources	Multifunction calibrators	Direct comparison	0.1	1000	mA	Frequency	10 Hz to 5 kHz	9.0E-05 to 3.0E-04	A/A	2	95%	Yes	ACI Sources and meters		162
AC current up to 100 A: sources	Multifunction calibrators	Direct comparison	1	10	A	Frequency	10 Hz to 10 kHz	1.2E-04 to 8.0E-04	A/A	2	95%	Yes	ACI Sources and meters		163
AC current up to 100 A: meters	AC ammeter, multimeters	Direct comparison	0.1	1	mA	Frequency	10 Hz to 5 kHz	1.1E-04 to 2.0E-04	A/A	2	95%	Yes	ACI Sources and meters		164
AC current up to 100 A: meters	AC ammeters, multimeters	Direct comparison	1	1000	mA	Frequency	10 Hz to 5 kHz	9.0E-05 to 3.0E-04	A/A	2	95%	Yes	ACI Sources and meters		165
AC current up to 100 A: meters	AC ammeters, multimeters	Direct comparison	1	10	A	Frequency	10 Hz to 10 kHz	1.2E-04 to 8.0E-04	A/A	2	95%	Yes	ACI Sources and meters		166
AC power and energy: single phase ($f \leq 400$ Hz), active energy	Energy meters	Direct comparison with standard	1.25	54000	Wh	Voltage	50 V to 450 V	1E-04	Wh/VAh	1.65	95%	Yes		The measurand range is for 1 h	140a
						Current	0.05 A to 120 A								
						Power factor	1 to 0.5, inductive or capacitive								
						Frequency	47 Hz to 53 Hz								
						Measuring time	1 s to 999 s								
AC power and energy: single phase ($f \leq 400$ Hz), reactive energy	Energy meters	Direct comparison with standard	1.25	54000	varh	Voltage	50 V to 450 V	2E-04	varh/VAh	1.65	95%	Yes		The measurand range is for 1 h	140b
						Current	0.05 A to 120 A								
						sin ϕ	1 to 0.5, inductive or capacitive								
						Frequency	47 Hz to 53 Hz								
						Measuring time	1 s to 999 s								

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AC power and energy: three phase, active energy	Energy meters, active energy	Direct comparison with standard	3.75	162000	Wh	Voltage	50 V to 450 V	5E-04	Wh/VAh	1.65	95%	Yes		The ranges for voltage and current are per phase, the measurand range is per three phases for 1 h	141a
						Current	0.05 A to 120 A								
						Power factor	1 to 0.5, inductive or capacitive								
						Frequency	47 Hz to 53 Hz								
						Measuring time	1 s to 999 s								
AC power and energy: three phase, reactive energy	Energy meters, reactive energy	Direct comparison with standard	3.75	162000	varh	Voltage	50 V to 450 V	1E-03	varh/VAh	1.65	95%	Yes		The ranges for voltage and current are per phase, the measurand range is per three phases for 1 h	141b
						Current	0.05 A to 120 A								
						sinφ	1 to 0.5, inductive or capacitive								
						Frequency	47 Hz to 53 Hz								
						Measuring time	1 s to 999 s								
AC high voltage: ratio error	Voltage transformers	Bridge method with instrument transformer test set	0	1E-02		Primary voltage	100 V to 350 kV	5E-05		2	95%	No			142
						Secondary voltage	20 V to 240 V								
						Frequency	50 Hz								
AC high voltage: ratio: phase displacement d	Voltage transformers, phase displacement d	Bridge method with instrument transformer test set	0	200	'	Primary voltage	100 V to 350 kV	(0.5 + 0.01d), d in minute	,	2	95%	No			142a
						Secondary voltage	20 V to 240 V								

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Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
						Frequency	50 Hz								
High AC current: ratio error	Current transformers	Bridge method with instrument transformer test set	0	1E-02		Primary current	0.1 A to 2 A	1.E-04		2	95%	No			143
						Secondary current	1 A or 2 A or 5 A								
						Frequency	50 Hz								
High AC current: ratio: phase displacement d	Current transformers, phase displacement d	Bridge method with instrument transformer test set	0	200	'	Primary current	0.1 A to 2 A	(0.5 + 0.01 d), d in minute	,	2	95%	No			143a
						Secondary current	1 A or 2 A or 5 A								
						Frequency	50 Hz								
High AC current: ratio error	Current transformers	Bridge method with instrument transformer test set	0	1E-02		Primary current	2 A to 10 kA	3.E-05		2	95%	No			143b
						Secondary current	1 A or 2 A or 5 A								
						Frequency	50 Hz								
High AC current: ratio: phase displacement d	Current transformers, phase displacement d	Bridge method with instrument transformer test set	0	200	'	Primary current	2 A to 10 kA	(0.2 + 0.01 d), d in minute	,	2	95%	No			143c
						Secondary current	1 A or 2 A or 5 A								
						Frequency	50 Hz								

Electricity and Magnetism, Poland, GUM (Glowny Urzad Miar, Central Office of Measures)
uncertainties table: ACV_Sources_and_meters

AC voltage up to 1000 V: sources, GUM Internal Identifier: 153, 154, 155, and 156

AC voltage up to 1000 V: meters, GUM Internal Identifier: 157, 158, 159, 160, 161, and 105

	10 Hz	20 Hz	30Hz	40Hz	55 Hz	300 Hz	1 kHz	10 kHz	20 kHz	30 kHz	50 kHz	100 kHz	300 kHz	500 kHz	1 MHz
1 mV	-	3.6E-04	3.6E-04	3.6E-04	3.3E-04	2.9E-04	2.9E-04	3.3E-04	3.5E-04	5.0E-04	5.0E-04	9.9E-04	-	-	-
10 mV	-	2.0E-04	2.0E-04	2.0E-04	1.9E-04	1.5E-04	1.5E-04	1.9E-04	2.0E-04	3.1E-04	3.1E-04	6.4E-04	-	-	-
100 mV	-	1.5E-04	1.5E-04	1.5E-04	1.4E-04	9.8E-05	9.8E-05	1.2E-04	1.4E-04	2.5E-04	2.5E-04	5.7E-04	-	-	-
1V	4.7E-05	4.7E-05	4.7E-05	3.1E-05	2.9E-05	2.6E-05	2.6E-05	2.9E-05	2.9E-05	3.1E-05	4.0E-05	5.9E-05	1.5E-04	3.2E-04	1.1E-03
10 V	4.7E-05	4.7E-05	4.7E-05	3.1E-05	2.9E-05	2.6E-05	2.6E-05	2.9E-05	2.9E-05	3.4E-05	3.4E-05	4.2E-05	1.3E-04	2.9E-04	1.1E-03
19 V	-	-	-	-	-	-	2.6E-05	-	-	-	-	-	-	-	-
100 V	5.3E-05	5.3E-05	5.3E-05	4.7E-05	4.3E-05	2.9E-05	2.9E-05	3.1E-05	3.1E-05	3.8E-05	4.6E-05	1.0E-04	-	-	-
700 V	-	-	-	-	-	-	-	-	-	-	1.4E-04	5.5E-04	-	-	-
1000 V	-	-	-	4.8E-05	4.4E-05	4.1E-05	4.1E-05	5.0E-05	5.6E-05	9.6E-05	-	-	-	-	-

The expanded uncertainties given in this table are expressed in V/V

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uncertainties table: ACI_Sources_and_meters

AC current up to 100 A: sources, GUM Internal Identifier: 162 and 163

AC current up to 100 A: meters, GUM Internal Identifier: 164, 165, and 166

	10 Hz	20 Hz	30 Hz	40 Hz	55 Hz	300 Hz	1 kHz	5 kHz	10 kHz
100 µA	1.3E-04	1.3E-04	1.2E-04	1.2E-04	1.1E-04	1.1E-04	1.1E-04	1.9E-04	-
1 mA	1.3E-04	1.3E-04	1.2E-04	1.1E-04	1.1E-04	1.1E-04	1.1E-04	2.0E-04	-
10 mA	1.2E-04	1.2E-04	1.2E-04	9.0E-05	1.1E-04	1.1E-04	1.1E-04	1.8E-04	-
100 mA	1.2E-04	1.2E-04	1.2E-04	1.1E-04	1.1E-04	1.1E-04	1.1E-04	1.8E-04	-
1 A	1.8E-04	1.8E-04	1.7E-04	1.2E-04	1.2E-04	1.2E-04	1.5E-04	3.0E-04	-
10 A	3.7E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	5.4E-04	8.0E-04

The expanded uncertainties given in this table are expressed in A/A